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LONG DATABASE REPORT NEOTROPICAL VEGETATION

CACTUS – Vegetation database of the Dutch Caribbean Islands

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Abstract

The vegetation database CACTUS (registered in GIVD under SA-00-004) aims to bring together all plot-based relevés from the Dutch Caribbean Islands that are available from literature, unpublished resources, and recent field surveys. The database currently contains 2,701 vegetation descriptions. The database is used for vegetation classification, to investigate vegetation change over time, to assist in the planning of vegetation surveys, as a source for plant species distribution maps, and to inform nature conservation and policy.

Taxonomic references: Van Proosdij (2012) for the Leeward Islands, Axelrod (2017, 2021) for the Windward Islands, except for St. Martin (Howard 1974-1989).

Keywords

Caribbean region, islands, Neotropics, plant species, syntaxonomy, vegetation, vegetation database, vegetation plot

PENSOFT

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GIVD Fact Sheet: CACTUS

GIVD Database ID: SA-00-004			**Last update:** 2023-01-27
CACTUS		**Web address:**	
Database manager(s): John Janssen (john.jansssen@wur.nl); Erik Houtepen (e.houtepen@carmabi.org)			
Owner: John Janssen			
Scope: The database contains relevés of all vegetation types on the islands Aruba, Bonaire, Curaçao, Sint Maarten, Sint Eustatius and Saba (Dutch Caribbean), digitized from literature, field forms, and recently made. The represented vegetation ranges from seagrass beds and mangroves to dry thornscrub and cactus fields, to dry and wet tropical forest.			
Abstract: The vegetation database CACTUS contains plot-based relevés of the Dutch Caribbean Islands that are available from literature, unpublished resources and recent field surveys. The database currently contains 2701 vegetation descriptions, of which about 320 are resurveyed plots. The database is used for vegetation classification, as reference for developments and vegetation succession, as a source for plant species distribution maps, and for applications in nature policy and conservation.			
Availability: according to a specific agreement		**Online upload:** no	**Online search:** no
Database format(s): TURBOVEG		**Export format(s):** TURBOVEG	
Plot type(s): normal plots, time series		**Plot-size range (m^2):** 4 to 2500	
Non-overlapping plots: 2381	**Estimate of existing plots:** 2701	**Completeness:** 100%	**Status:** ongoing capture
Total no. of plot observations: 2701	**Number of sources (biblioreferences, data collectors):** 45		**Valid taxa:** 1029
Countries (%): AW: 27; CW: 42; SX: 4; NL: 27			
Formations: Forest: 12% = Semi-aquatic: 8%; Terrestrial: 4% // Non Forest: 87% = Aquatic: 3%; Semi-aquatic: 2%; Terrestrial: 82%			
Guilds: all vascular plants: 100%			
Environmental data (%): altitude: 32			
Performance measure(s): cover: 100%			
Geographic localization: GPS coordinates (precision 25 m or less): 74%; point coordinates less precise than GPS, up to 1 km: 17%; small grid (not coarser than 10 km): 9%			
Sampling periods: 1950-1959: 5%; 1960-1969: 0%; 1970-1979: 4%; 1980-1989: 22%; 1990-1999: 33%; 2000-2009: 6%; 2010-2019: 15%; after 2020: 15%; unknown: 0%			
Information as of 2023-01-27; further details and future updates available from http://www.givd.info/ID/SA-00-004			

Introduction

In the Caribbean region, six islands form a part of the Kingdom of the Netherlands. Three of these are independent countries (Aruba, Curaçao, Sint Maarten), while the other three are special municipalities of The Netherlands (Bonaire, Sint Eustatius, Saba). They are situated in the chain of islands known as the Lesser Antilles, in a region where the prevailing so-called trade winds are blowing from an eastnortheast direction. Aruba, Bonaire and Curaçao are situated close to the coast of Venezuela, and – because of their position toward the trade winds – are called the Leeward Antilles (from the perspective of Dutch sailors). Sint Maarten, Sint Eustatius and Saba are situated at a latitude approximately 5.5 degrees further north, and are known in the Netherlands as the Windward Antilles. The Leeward Islands are situated in a region with a dry, semi-arid tropical climate, in the rain-shade of the mountain chain at the northern coast of the South-American continent. The Windward Islands have a subtropical climate, with much higher precipitation, and are in a region that experiences hurricanes in the autumn. On all islands rainfall depends strongly on the altitude. The highest (volcanic) mountains are found on the islands Saba (887 m) and Sint Eustatius (601 m). On these mountains rain forests are found. The highest point in the leeward islands is the Sint-Christoffelberg on Curaçao (375 m). The soil of the islands has mainly three types of origin: volcanic soils, limestone soils and – on Curaçao – the Knip formation, consisting of deep water sediments of siliceous deposits. Besides these main soils, alluvial soils and recent marine sediments are also found.

The six islands are situated within one of the world hotspots for biodiversity: the Caribbean Hotspot (Myers et al. 2000). The Caribbean region contains approximately 11,000 native plant species, among which a relatively large amount (72%) are endemics (Acevedo-Rodríguez and Strong 2008). The biodiversity of the region is under severe pressure, especially because of increasing tourism, urbanisation, land exploitation (grazing by livestock) and related soil erosion, climate change and invasive non-native plants and animals (Debrot et al. 2018). Despite the importance of the region from the point-of-view of biodiversity, the knowledge and data on its terrestrial ecosystems, flora and fauna are limited. Although much information has been published, most of it exists in internal and student reports. Especially for terrestrial ecosystems, large data gaps exist, as nature conservation is often focused on marine systems, especially coral reefs. To fill one of these data gaps, five

years ago a project was started to construct a database of the vegetation relevés recorded from the six islands. This project is a partnership between Wageningen University & Research (Netherlands) and Carmabi (Curaçao).

The CACTUS database

The vegetation database is called CACTUS, an acronym for Caribbean Communities Turboveg System. It is available in both the database systems Turboveg2 and Turboveg3 (Hennekens and Schaminée 2001). The database consists of digitized relevés from literature, digitized relevés used for vegetation mapping during the 1990s which were only published as synoptic tables, digitized relevés from student reports, and recently recorded additional relevés. On January 1st 2023 a total of 2,701 relevés were stored in the database, of which about 90% has been geo-referenced through Longitude/Latitude-coordinates. The database is included in the Global Index of Vegetation-Plot Databases (GIVD) with ID SA-00-004.

Fig. 1 provides an overview of the time periods in which the relevés were recorded. The oldest relevés are from 1952, when the first extensive vegetation survey was conducted (Stoffers 1956). Some of the largest sets of relevés, that date from the 1980s and 1990s, are derived from student reports like Bokkestijn and Slijkhuis (1987), Beers and Van der Have (1989), Roest (1995), and island inventories, like Beers et al. (1997) and De Freitas et al. (2005, 2016). Fig. 2 gives an overview of how many relevés from each of the islands have been digitized.

The majority of relevés were recorded on the Leeward Islands, especially on Curaçao and Aruba. Fig. 3 provides maps of the six islands and the distribution of all geo-referenced plots. The zonal vegetation that is represented in the database consists of tropical rainforest and cloud forest, dry tropical forest and woodland, xeromorphic woodland and cactus scrub, secondary tropical shrubland, grassland and pioneer communities (Fig. 4). Azonal vegetation is represented by plots from alluvial forests, mangroves, salt marshes, dunes, permanent and temporary wetlands, rock slopes, and seagrass beds.

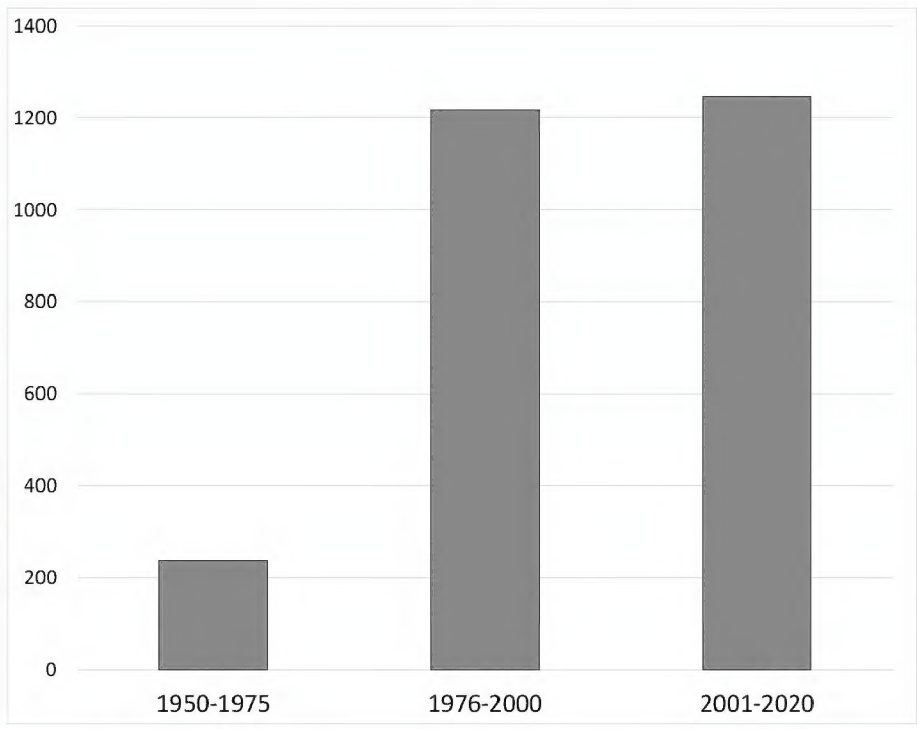

Figure 1. Periods in which relevés from the CACTUS database were recorded.

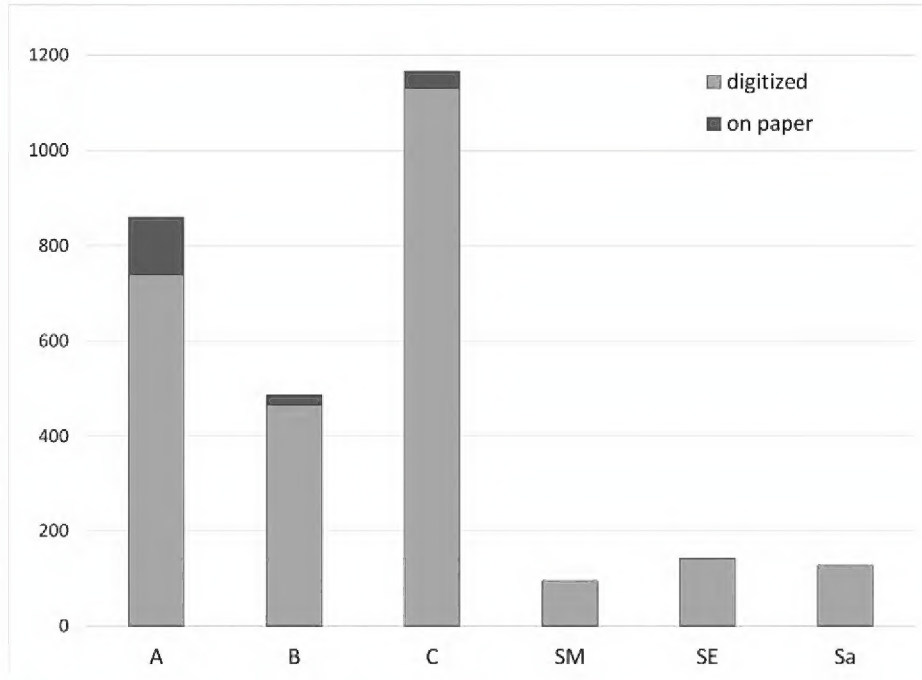

Figure 2. Number of relevés in the CACTUS database from each of the Dutch Caribbean islands (blue), as well as number of known relevés that have not been digitized yet (orange; A= Aruba, B= Bonaire, C= Curaçao, SM = Sint Maarten, SE = Sint Eustatius, Sa = Saba).

The database CACTUS uses a complete species list with synonyms (vascular plants only) for the six islands. The taxonomy is based on Van Proosdij (2012) for the Leeward Islands, the species lists of Sint Eustatius and Saba (Axelrod 2017, 2021) for the Windward Islands, and additional species for Sint Maarten from the (relatively old) Flora of Howard (1974–1989). In the near future all species names will be updated according to http://www.worldfloraonline.org/. The list is updated frequently, e.g. when new species are discovered. It contains limited amounts of trait data for the species as well, for example on geographical distribution, growth form and indigeneity. Several species are endemics for one or multiple of the six Dutch islands (see for example Van Proosdij 2012; Axelrod 2017, 2021; Griffith et al. 2019).

Outlook

Currently, the database is used in different ways. First of all, several of the sites with older historical relevés have been resurveyed or are planned to be resurveyed. Such studies have been carried out for the Christoffel National Park on Curaçao, for the island of Saba, parts of Aruba, while a resurvey of Sint Eustatius and Bonaire is scheduled for 2023 and 2024; the results from these studies have not been published yet. Resampling of historical plots provides an indication of vegetation change and provides insight into the processes that drive vegetation succession. This type of knowledge is crucial for the prediction of future vegetation developments, caused by changes in climate, management or land use.

Secondly, we aim to use the data set to provide a plot-based, objective, and quantitative overview of the plant communities recorded on the six islands, which will be

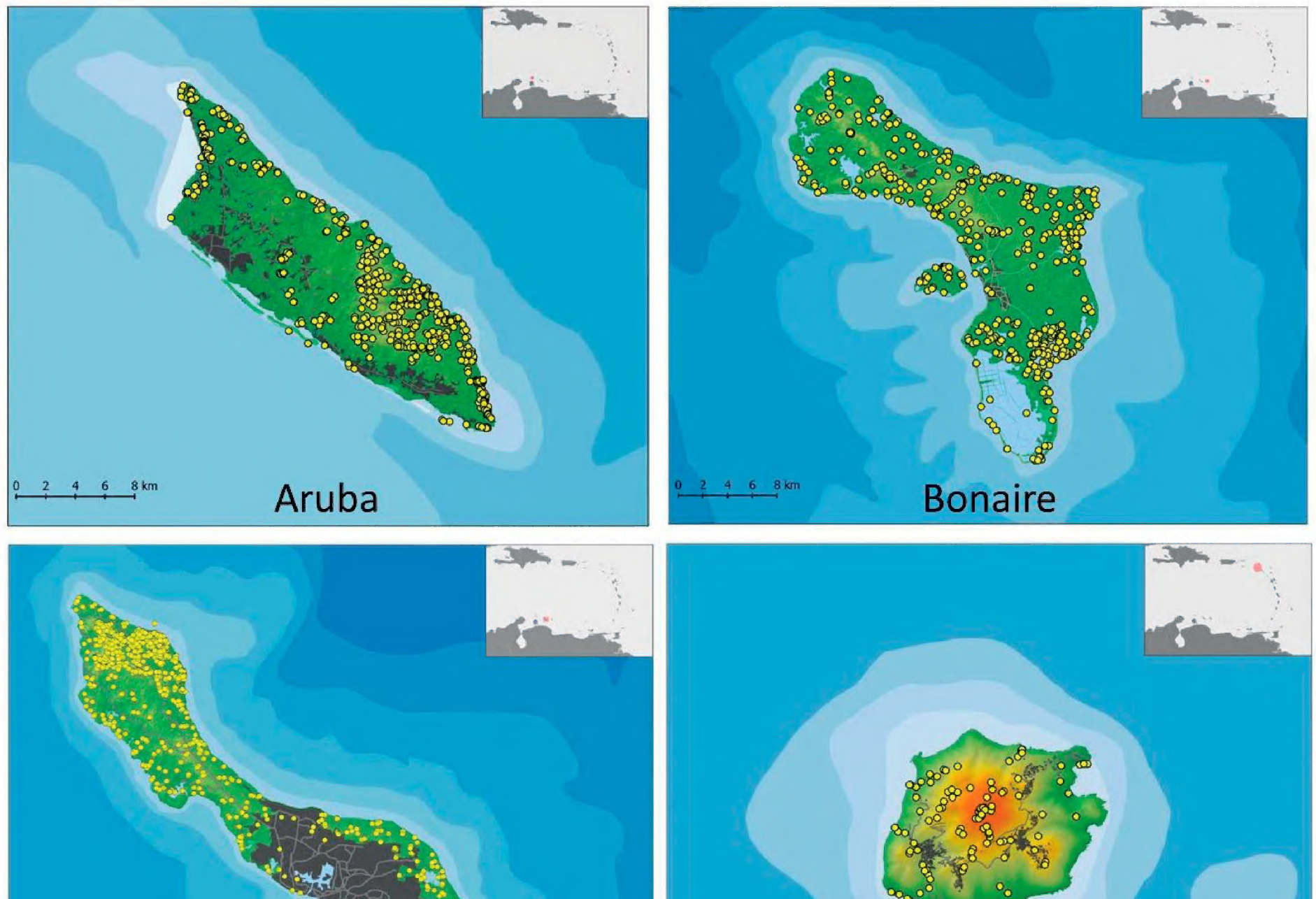

Figure 3. Distribution of relevés in the CACTUS database (indicated by yellow dots) on the Leeward Islands Aruba, Bonaire, Curaçao and the Windward Islands Saba, Sint Eustatius and Sint Maarten/Saint Martin. The position of each island in the wider Caribbean region is indicated by a red dot in the small map in the corner of each island map.

related to classification schemes for regions with a similar climate and flora (for example the north-coast of Colombia and Venezuela) and the wider Caribbean region.

Thirdly, the vegetation database forms an important source for the creation of plant species distribution maps, which are available at http://speciesdistribution.dcbd.nl/. These maps are updated regularly, in case new data are added to the CACTUS database. Plant species distribution maps are important for Red List assessments of species. For this purpose, the relevé data from CACTUS are com-

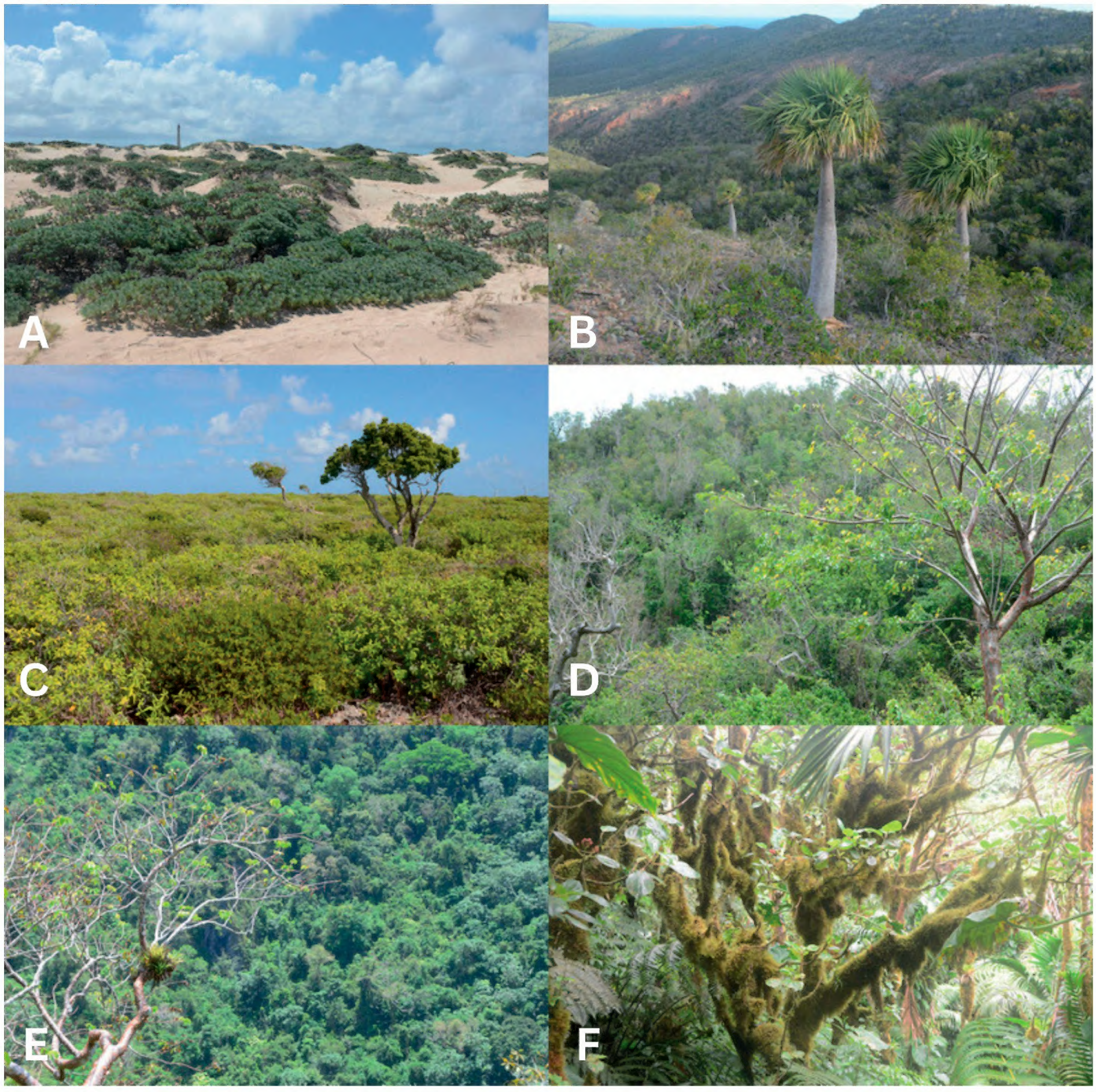

Figure 4. Examples of vegetation types represented in the CACTUS database: A. dune shrubland on Aruba, B. scree communities with the endemic palm *Sabal antillensis* on Curaçao, C. limestone shrubland with *Stenostomum acutatum* and *Jacquinia arborea* on Aruba, D. dry tropical forest with *Bursera simaruba* on Sint Maarten, E. secondary rain forest on the slopes of the Quill volcano Sint Eustatius, and F. Elfin forest dominated by *Freziera undulata* on Saba.

bined with the distribution data for species from herbaria, photographs, literature and other databases. The plant species distribution database currently contains more than 50,000 unique observations.

Finally, the database can be used directly to inform nature conservation and policy, for example, to indicate priority areas for conservation or for environmental impact assessment studies. An example of this is the nature-inclusive development vision for Bonaire (Verweij et al. 2020), in which priority areas have been selected on the island of Bonaire based on an analysis of the CACTUS data.

The establishment of the CACTUS database and its continuing development and use forms part of a worldwide initiative that aims to base nature policy and management on evidence and data (Sutherland et al. 2004; Pullin and Knight 2009).

Author contributions

J.J. and E.H. initiated and maintain the database, A.v.P. initiated and maintains the species list, S.H. supports with all technical aspects and the related website.

Acknowledgements

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